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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/858,337	05/15/2001	William J. Schaff	1153.044US1	1100
21186 7590 02/19/2009 SCHWEGMAN, LUNDBERG & WOESSNER, P.A. P.O. BOX 2938 MINNEAPOLIS, MN 55402				
EXAMINER DUONG, KHANH B				
ART UNIT 2822		PAPER NUMBER		
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

### Office Action Summary

**Application No.**

09/858,337

**Applicant(s)**

SCHAFF ET AL.

**Examiner**

KHANH B. DUONG

**Art Unit**

2822

**Period for Reply** -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 06 February 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-9, 11-19 and 31 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 17-19 and 31 is/are allowed.
- 6) ☒ Claim(s) 1-9 and 11-15 is/are rejected.
- 7) ☒ Claim(s) 16 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/C)
- 4) ☐ Interview Summary (PTO-413)
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_
- Paper No(s)/Mail Date \_\_\_\_\_

### **DETAILED ACTION**

#### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114 was filed in this application after a decision by the Board of Patent Appeals and Interferences, but before the filing of a Notice of Appeal to the Court of Appeals for the Federal Circuit or the commencement of a civil action. Since this application is eligible for continued examination under 37 CFR 1.114 and the fee set forth in 37 CFR 1.17(e) has been timely paid, the appeal has been withdrawn pursuant to 37 CFR 1.114 and prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on February 6, 2009 has been entered.

#### ***Response to Amendment***

This office action is in response to the amendment filed on February 6, 2009.

Accordingly, claims 10 was canceled, claims 1, 4, 5, 7, 11 and 13 were amended and new claim 31 was added.

Currently, claims 1-9, 11-19 and 31 are pending.

#### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

**Claims 1 and 2 are rejected under 35 U.S.C. 103(a) as being unpatentable over Boos et al. (U.S. 5,364,816) in view of Carpenter (U.S. Patent No. 5,183,684).**

Boos et al. ("Boos") discloses in FIGs. 9-10C a method of forming a field effect transistor, the method comprising: forming a channel heterojunction field effect transistor having a top surface; and applying a SiN passivation layer directly on the top surface of the heterojunction channel field effect transistor to inherently reduce uncontrolled changing of charge states in the transistor.

Re claim 1, Boos discloses applying a SiN, instead of an AlN, passivation layer directly on the top surface of the heterojunction channel field effect transistor.

Carpenter suggests using AlN as a protection/passivation material for electronic devices because of the high refractory and chemically resistant nature of AlN coupled with other

properties such as a large energy gap, a high thermal conductivity, and a closely matched thermal expansion to silicon [see col. 2, lines 3-9].

Since Boos and Carpenter are from the same field of endeavor, the purpose disclosed by Carpenter would have been recognized in the pertinent prior art of Boos.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Boos as taught by Carpenter because of the desirability to provide a more superior passivation material for the channel heterojunction field effect transistor.

Re claim 2, Boos teaches the thickness of the AlN layer is between approximately 500 and 5,000 angstroms [see col. 3, lines 15-17].

**Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Boos and Carpenter as applied to claims 1 and 2 above, and further in view of Parmenter et al. (U.S. 5,026,454).**

Re claims 3 and 4, The combined disclosure of Boos and Carpenter do not disclose Al and N being applied alternately until a desired thickness of AlN is obtained, wherein a predetermined amount of time occurs between each alternate application.

Parmenter et al. ("Parmenter") teaches in FIG. 1 an MBE apparatus that utilizes shutters 21 and 24 to alternately open and close molecular or atomic beam sources 1 and 2, wherein the beams 1 and 2 are alternately applied for approximately 0.2 seconds or less, or for any length of time required by the deposition process [see col. 2, lines 52-65].

Since Boos, Carpenter and Parmenter are from the same field of endeavor, the purpose disclosed by Parmenter would have been recognized in the pertinent prior art of Boos and Carpenter.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the combined process of Boos and Carpenter with the teaching of Parmenter, since Parmenter states at column 1, line 34 to 35 that such modification would achieve accurate dosage of material at the substrate.

**Claims 5 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Boos in view of Carpenter and Yoshida (U.S. 6,281,099).**

Boos discloses in FIGs. 9-10C a method of forming a field effect transistor, the method comprising: forming a heterojunction channel field effect transistor having a top surface; and applying a SiN passivation layer directly and conformally on the top surface of the heterojunction channel field effect transistor.

Re claim 5, Boos does not disclose using molecular beam epitaxy to apply an AlN passivation layer to the top surface of the heterojunction channel field effect transistor.

Carpenter suggests using AlN as a protection/passivation material for electronic devices because of the high refractory and chemically resistant nature of AlN coupled with other properties such as a large energy gap, a high thermal conductivity, and a closely matched thermal expansion to silicon [see col. 2, lines 3-9]. However, Carpenter does not teach the use of molecular beam epitaxy to apply the AlN passivation layer. Yoshida, on the other hand, suggests forming an AlN layer using MBE [see col. 2, lines 45-48].

Since Boos, Carpenter and Yoshida are from the same field of endeavor, the purpose disclosed by Carpenter and Yoshida would have been recognized in the pertinent prior art of Boos.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Boos as taught by Carpenter and Yoshida because of the desirability to provide a more superior passivation material for the heterojunction channel field effect transistor.

Re claim 9, Boos teaches the AlN layer is applied to a desired thickness between approximately 500 and 5,000 angstroms [see col. 3, lines 15-17].

**Claims 6-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Boos in view of Carpenter and Yoshida as applied to claims 5 and 9 above, and further in view of Parmenter (U.S. 5,026,454).**

Re claims 6-8, the combined disclosure of Boos, Carpenter and Yoshida fails to disclose alternately applying Al and RF nitrogen beams at a predetermined amount of time between the alternating beams.

Parmenter et al. ("Parmenter") teaches in FIG. 1 an MBE apparatus that utilizes shutters 21 and 24 to alternately open and close molecular or atomic beam sources 1 and 2, wherein the beams 1 and 2 are alternately applied for approximately 0.2 seconds or less, or for any length of time required by the deposition process [see col. 2, lines 52-65].

Since Boos, Carpenter, Yoshida and Parmenter are from the same field of endeavor, the purpose disclosed by Parmenter would have been recognized in the pertinent prior art of Boos, Carpenter and Yoshida.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the combined process of Boos, Carpenter and Yoshida with the teaching of Parmenter, since Parmenter states at column 1, line 34 to 35 that such modification would achieve accurate dosage of material at the substrate.

Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select a process time between alternating beams as taught by Parmenter, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

**Claims 11-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Utumi in view of Parmenter and Yoshida.**

Utumi discloses method of forming a layer of AlN of desired thickness [see col. 6, lines 62 to col. 7, lines 12] on a semiconductor substrate, the method comprising: using molecular beam epitaxy (MBE): applying beams of Al; and applying beams of remote plasma RF nitrogen with the beams of Al to produce the layer of AlN of desired thickness directly on the device.

Re claim 11-15, Utumi fails to disclose alternately applying the beams of remote plasma RF nitrogen and the beams of Al at specific process parameters such as time and thickness as claimed.



Parmenter teaches in FIG. 1 an MBE apparatus that utilizes shutters 21 and 24 to alternately open and close molecular or atomic beam sources 1 and 2, wherein the beams 1 and 2 are alternately applied for approximately 0.2 seconds or less, or for any length of time required by the deposition process [see col. 2, lines 52-65]. However, Parmenter fails to mention any specific desired thickness of the AlN layer.

Yoshida suggests forming an AlN layer using MBE until a desired thickness between 0.05-1.0 microns (50-10,000 angstroms) is obtained [see col. 2, lines 45-48].

Since Utumi, Parmenter and Yoshida are all from the same field of endeavor, the purposes disclosed by Parmenter and Yoshida would have been recognized in the pertinent prior art of Utumi.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Utumi with the teaching of Parmenter, since Parmenter states at column 1, line 34 to 35 that such modification would achieve accurate dosage of material at the substrate. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select specific process parameters such as time and thickness within the ranges as combinatively suggested by Utumi, Parmenter and Yoshida, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

***Allowable Subject Matter***

Claim 16 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 17-19 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: none of the prior art of record, taken alone or in combination, fairly discloses all the limitations as claimed.

Re claim 17, none of the prior art of record discloses a method of forming a layer of AIN of desired thickness on a semiconductor substrate, the method comprising: using molecular beam epitaxy at a temperature less than approximately 300 degrees Celsius.

Re claim 31, none of the prior art of record discloses a method of forming a field effect transistor, the method comprising: using molecular beam epitaxy at approximately 150 degrees Celsius.

***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Liu '439, Omori '959 and McTeer '111 disclose relevant teachings regarding HFET and AIN passivation material.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khanh B. Duong whose telephone number is (571) 272-1836. The examiner can normally be reached on Monday-Friday from 8:30-4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith, can be reached on (571) 272-2429. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KBD

/N. Drew Richards/

Supervisory Patent Examiner, Art Unit 2895